## *On the Existence of Bright Lines in the Solar Spectrum.*

By W. H. M. Christie, Esq.

Since Professor H. Draper's announcement that bright lines corresponding to those of oxygen were to be detected in the solar spectrum, I have repeatedly examined various parts of the spectrum, and more particularly the neighbourhood of the G line, in the hope of being able to verify this important announcement. The result, however, has been that certain difficulties as regards the existence of bright lines have presented themselves, and I think it desirable to state these without further delay, although I have not been able to devote as much time to the inquiry as I could have wished. The lines in the solar spectrum present such a different appearance, according to the power of the spectroscope used, that a description of the aspect of the spectrum in the neighbourhood of the G line as seen with the half-prism spectroscope of the Royal Observatory, Greenwich, may throw some light on the question. With this spectroscope many fine lines, not shown in Ångström's or Kirchhoff's maps, or in Professor Draper's photograph, are readily seen, and the stronger absorption lines are comparatively narrow and sharply defined. As a consequence of this a space between two dark lines which, with a spectroscope of lower power, looks like a bright line, loses this appearance altogether, and seems to be nothing but the background of continuous spectrum. In the diagram representing the spectrum on the less refrangible side of G, four spaces are formed by the strong lines at 4314·4, 4316·3, 4318·1, and 4320·2, which, with a lower dispersive power or less perfect definition, might be taken as bright lines, and, in fact, Professor H. Draper has identified the two inner as a double line of oxygen. But, as seen at Greenwich, the spaces are each about ten times the breadth of the dark lines and of perfectly even tint, without any trace of fuzziness at the edges. Now it seems difficult to explain the existence of bright lines which remain of sensible breadth and sharply defined at the edges when the slit of the spectroscope is closed. In ordinary cases, where a bright line (such as $H_\beta$ at atmospheric pressure) has a breadth much greater than that of the slit, it is fuzzy at the edges, whereas the spaces or 'bright lines' in question are perfectly even in tint. Further, I have not been able to distinguish the slightest difference in tint in the whole portion from 4312 to 4322, and this under conditions which showed, in each of the spaces, two fine absorption lines of which not a trace is to be found on Professor Draper's photograph. In making this statement, however, it must be understood that I am referring to the Albertype print, in which, doubtless, some of the definition of the original negative would be lost. I have not had an opportunity of seeing the latter. However this may be, the definition, when these observations

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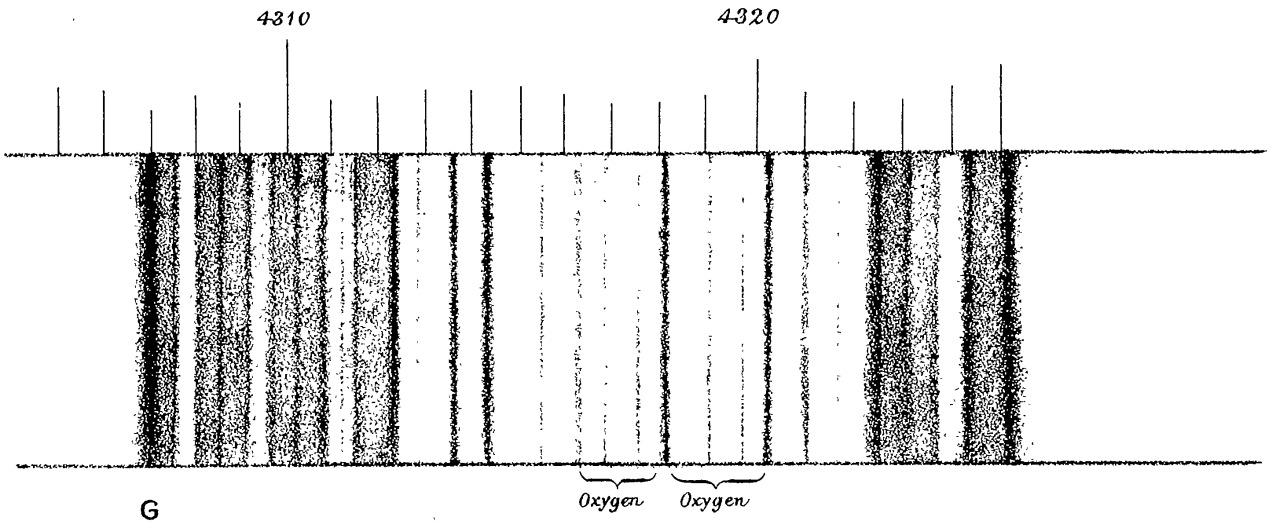
ROYAL OBSERVATORY GREENWICH.

SOLAR SPECTRUM NEAR G AS SEEN WITH HALF-PRISM SPECTROSCOPE.




PROF. DRAPER'S BRIGHT LINES.

Spottiswoode & Co Lith. London.

with the half-prism spectroscope were made, was sufficiently good to show ten absorption lines in a space where Angström's map shows only three. The circumstance that there are absorption lines in these spaces seems to me to present another difficulty in accepting the view that the spaces in question are bright lines.

As Professor H. Draper attaches much importance to the evidence of photography, I have also taken a few photographs of this part of the spectrum, in which the relative breadths of the absorption lines, as compared with the spaces between them, and the fine lines seen in these spaces agree exactly with the eye-view. These photographs, which I beg to lay before the meeting, were taken with exposures ranging from $1^s$ to $5^s$ (according to the state of the sky) the width of the slit being about 1-5000th of an inch. But hitherto no comparison has been made at Greenwich with the spectrum of oxygen, my attention having been directed entirely to the character of the solar spectrum apart from the question of coincidences of spaces with the bright lines of oxygen. The comparison of the two spectra presents great practical difficulties, and the character of the solar spectrum is, after all, the question of primary importance. It might seem, at first sight, that the coincidence of a large number of lines of oxygen with spaces in the solar spectrum would be sufficient in itself to prove that these spaces are really bright lines, but it must be remembered that, as there are no coincidences of oxygen with dark lines in the solar spectrum, every line of oxygen must correspond approximately to a space, and this is all that can be asserted, so far, from the Albertype print of Professor Draper's photograph, in which the dark lines and spaces are of about equal breadth and fuzzy at the edges. If, however, an *exact* coincidence could be established within small limits of error on the original negative, the case would be altered. But the spectrum must be magnified many times to give the requisite accuracy. In this connexion it may be well to mention that the diagram is on a scale fifteen times that of Professor Draper's photograph and represents fairly the accuracy attainable in eye observation.

The observations were made with the half-prism spectroscope, in which a train of two compound half-prisms (direct vision) gives a dispersion of 75° from A to H, equivalent to 15 prisms of 60°. The spectroscope was used in connexion with the Great Equatoreal of the Royal Observatory, which forms an image of the Sun two inches in diameter on the slit, thus avoiding the confusion of definition which, as Capt. Abney has pointed out, would, to a certain extent, result from the effect of the Sun's rotation when a heliostat is used. In this examination of the spectrum I have received much assistance from Mr. Maunder.

1878, *June* 13.

## *Ephemeris for finding the position of the Satellite of Neptune.*

By Mr. A. Marth.

| Gr. Noon. 1878. | P ° | *a* ″ | *b* ″ | log. *a* | log. *b* | Long. ° | Diff. ° |
|---|---|---|---|---|---|---|---|
| Aug. 13 | 311·71 | 16·53 | 5·87 | 1·2182 | 0·7690 | 245·64 | |
| | | | | | | | 612·59 |
| 23 | 311·69 | 16·62 | 5·91 | ·2206 | ·7713 | 138·23 | |
| | | | | | | | ·54 |
| Sept. 2 | 311·65 | 16·70 | 5·93 | ·2228 | ·7729 | 30·77 | |
| | | | | | | | ·49 |
| 12 | 311·58 | 16·78 | 5·94 | ·2248 | ·7737 | 283·26 | |
| | | | | | | | ·44 |
| 22 | 311·48 | 16·85 | 5·94 | ·2266 | ·7738 | 175·70 | |
| | | | | | | | ·40 |
| Oct. 2 | 311·36 | 16·90 | 5·93 | 1·2280 | 0·7731 | 68·10 | |
| | | | | | | | 612·36 |
| 12 | 311·22 | 16·95 | 5·91 | ·2291 | ·7717 | 320·46 | |
| | | | | | | | ·33 |
| 22 | 311·08 | 16·97 | 5·88 | ·2297 | ·7696 | 212·79 | |
| | | | | | | | ·31 |
| Nov. 1 | 310·93 | 16·98 | 5·85 | ·2299 | ·7669 | 105·10 | |
| | | | | | | | ·31 |
| 11 | 310·79 | 16·97 | 5·80 | ·2296 | ·7636 | 357·41 | |
| | | | | | | | ·31 |
| 21 | 310·65 | 16·94 | 5·75 | ·2288 | ·7600 | 249·72 | |
| | | | | | | | ·32 |
| Dec. 1 | 310·52 | 16·89 | 5·70 | 1·2276 | 0·7561 | 142·04 | |
| | | | | | | | 612·34 |
| 11 | 310·41 | 16·83 | 5·65 | ·2261 | ·7521 | 34·38 | |
| | | | | | | | ·37 |
| 21 | 310·33 | 16·76 | 5·60 | ·2242 | ·7482 | 286·75 | |
| | | | | | | | ·41 |
| 31 | 310·27 | 16·67 | 5·55 | ·2220 | ·7445 | 179·16 | |
| | | | | | | | ·46 |
| 1879. Jan. 10 | 310·24 | 16·58 | 5·51 | ·2196 | ·7412 | 71·62 | |
| | | | | | | | ·50 |
| 20 | 310·23 | 16·49 | 5·48 | ·2171 | ·7385 | 324·12 | |
| | | | | | | | ·55 |
| 30 | 310·25 | 16·39 | 5·45 | ·2146 | ·7363 | 216·67 | |
| | | | | | | | 612·61 |
| Feb. 9 | 310·31 | 16·30 | 5·43 | 1·2121 | 0·7347 | 109·28 | |

P, angle of position of the minor axis of the apparent orbit in the direction of superior conjunction.

*a*, *b*, major and minor semi-axes of apparent orbit.

Long. = longitude of the satellite in its orbit, reckoned from the point which is in superior conjunction with the planet.

The values of the table are to be interpolated for the times for which the places of the satellite are required, and the position-angles $p$ and distances $s$ are then found by

$$s \sin (P-p) = a \sin \text{long.}$$

$$s \cos (P-p) = b \cos \text{long.}$$

To know whereabout the satellite is situated it will be sufficient

to know the approximate times of its superior ($p = 311°$) and inferior ($p = 131°$) conjunctions, and to construct the apparent ellipse.

| 1878. | G.M.T. h | | 1878. | G.M.T. h | | 1878. | G.M.T. h | |
|---|---|---|---|---|---|---|---|---|
| Aug. 14 | 21 | sup. | Oct. 15 | 14 | inf. | Dec. 16 | 8 | sup. |
| 17 | 19 | inf. | 18 | 13 | sup. | 19 | 6 | inf. |
| 20 | 18 | sup. | 21 | 11 | inf. | 22 | 5 | sup. |
| 23 | 16 | inf. | 24 | 10 | sup. | 25 | 3 | inf. |
| 26 | 15 | sup. | 27 | 8 | inf. | 28 | 2 | sup. |
| 29 | 13 | inf. | 30 | 7 | sup. | 31 | 0 | inf. |
| Sept. 1 | 12 | sup. | Nov. 2 | 5 | inf. | 1879. | | |
| 4 | 10 | inf. | 5 | 4 | sup. | Jan. 2 | 23 | sup. |
| 7 | 9 | sup. | 8 | 2 | inf. | 5 | 21 | inf. |
| 10 | 8 | inf. | 11 | 1 | sup. | 8 | 20 | sup. |
| 13 | 6 | sup. | 14 | 0 | inf. | 11 | 18 | inf. |
| 16 | 5 | inf. | 16 | 22 | sup. | 14 | 17 | sup. |
| 19 | 3 | sup. | 19 | 21 | inf. | 17 | 16 | inf. |
| 22 | 2 | inf. | 22 | 19 | sup. | 20 | 14 | sup. |
| 25 | 0 | sup. | 25 | 18 | inf. | 23 | 13 | inf. |
| 27 | 23 | inf. | 28 | 16 | sup. | 26 | 11 | sup. |
| 30 | 21 | sup. | Dec. 1 | 15 | inf. | 29 | 10 | inf. |
| Oct. 3 | 20 | inf. | 4 | 13 | sup. | Feb. 1 | 8 | sup. |
| 6 | 18 | sup. | 7 | 12 | inf. | 4 | 7 | inf. |
| 9 | 17 | inf. | 10 | 11 | sup. | 7 | 5 | sup. |
| 12 | 15 | sup. | 13 | 9 | inf. | 10 | 4 | inf. |

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## *Note on the Duplicity of the Companion to Rigel.*

By S. W. Burnham, Esq.

More than six years ago, when using a power of 400 on my 6-inch Clark Refractor, I noticed what appeared to be a slight but decided elongation in the companion to *Rigel*, nearly in the direction of the primary. I called the attention of observers to this (*English Mechanic*, February 9, 1872), and subsequently examined the star many times with the same instrument, but was never able to satisfy myself fully that the small star was really double, and the evidence from other quarters was either negative or unfavourable. Some years later Mr. Herbert Sadler wrote me that he had noticed the same peculiar appearance in the small star, independently, I believe, and I again, in 1876,